

50
11
R4

Establishment of a lichen biomonitoring program

BRIGHAM YOUNG
UNIVERSITY

THE GLORY OF GOD
IS INTELLIGENCE

May 3, 1989

Rob Hendricks
Sawtooth National Forest
2647 Kimberly Road East
Twin Falls, Idaho 83301-7976

Dear Rob:

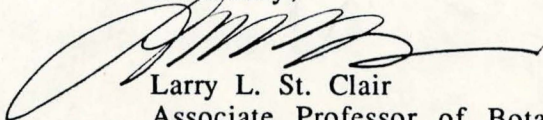
I am enclosing a copy of my report concerning the establishment of a lichen biomonitoring program for the Sawtooth National Recreation Area. I have summarized my observations as well as my recommendations. Generally speaking, I feel that air quality at the sites studied so far is very good, in fact very close to the Salmon National Forest sites, which we also looked at last July. This kind of data provides an effective baseline for monitoring future changes in the lichen flora of the Sawtooth which can, in turn, be used to predict air pollution impact in this critical airshed. If you have further questions about any phase of the project please don't hesitate to let me know.

A total of 80 samples were analyzed (8 samples X 10 replicates) for Cu, Pb and S at a cost of \$10.00/sample for a total cost of \$800.00. Payment should be made to:

Larry L. St. Clair
Department of Botany and Range Science
Brigham Young University
Provo, Utah 84602

I am currently planning on spending a week during the month of July setting up at least three or four more sites in other parts of the Sawtooth. Based on our earlier conversation I am planning on about a \$1000.00 for expenses and travel, as well as about \$1000.00 for elemental analysis of indicator species for this summer's collections. I have duplicate packets for all of the species on the species list which I will label and organize so that it can be added to the Forest Herbarium. As I mentioned the other day, to do this right I will need about \$100.00 to purchase special herbarium drawers which cost about \$50.00 apiece. This arrangement will provide the Forest with a permanent, well curated, duplicate collection of the various lichen species collected during the course of this project. I will call you about the 15th of May to finalize the details for this summer.

Sincerely,



Larry L. St. Clair
Associate Professor of Botany

Thesis/
Reports
St. Clair,
L. L.

**ESTABLISHMENT OF A LICHEN BIOMONITORING PROGRAM
FOR THE SAWTOOTH NATIONAL RECREATION AREA,
SAWTOOTH NATIONAL FOREST, IDAHO**

A REPORT

SUBMITTED TO:

**ROB HENDRICKS
SAWTOOTH NATIONAL FOREST
TWIN FALLS, IDAHO 83301**

PREPARED BY:

**LARRY L. ST. CLAIR
ASSOCIATE PROFESSOR OF BOTANY
DEPARTMENT OF BOTANY AND RANGE SCIENCE
BRIGHAM YOUNG UNIVERSITY
PROVO, UTAH 84602**

3 MAY 1989

Property of
National FS Library
USDA Forest Service
240 W Prospect Rd
Fort Collins CO 80526

Background Information:

During the summer of 1988 an air quality biomonitoring program, using lichens, was initiated for the Sawtooth National Recreation Area. Preliminary collections were made at four separate sites, Farley Lake, Alpine Lake, North Alpine Basin, and the pass between North Alpine Basin and Flytrip Basin. This program was established in an effort to obtain data which could be used to corroborate data from the extensive water sampling program now underway. Thus far, a preliminary checklist of the lichen species at these sites has been compiled (Table 1.) and elemental analysis of 1-3 air pollution sensitive indicator species for Pb, S, and Cu at each reference site has been completed (Table 2.).

General Observations:

1. The lichen flora of the Sawtooth National Recreation Area is diverse and well established at all study sites.
2. Preliminary collections have yielded a total of 79 species in 38 genera. In light of the limited amount of time spent collecting this represents a substantial number of species. Further collections should ultimately result in a list of at least 100 to 150 total species for the study area.
3. Alpine lake and North Alpine Basin have the lowest species diversity, with 23 and 24 total species respectively. On the other hand, Farley Lake and the pass between Flytrip Basin and North Alpine Basin have the greatest species diversity with 44 total species each. Increased species diversity at the Farley Lake site can be accounted for by the large number of lichen species collected from mature Doug fir trees.
4. All growth forms and substrate types are well represented at all study sites.
5. Copper, lead, and sulfur values (see Table 2.) for the indicator species, at each of the reference sites, were generally low. For example, lead and copper values were consistently low, even the 102.50 ppm of lead for Dermatocarpon miniatum at Farley Lake is well below levels encountered in polluted areas. The reason for the higher lead value at this site is not clear, however, it is possible that Dermatocarpon miniatum may be accumulating lead from its substrate. Sulfur values for both Letharia vulpina and Letharia columbiana were

consistently well below the critical 0.20% level, however, Dermatocarpon miniatum from North Alpine Basin, Farley Lake and Alpine Lake consistently demonstrated very high sulfur values. Recent studies now indicate that Dermatocarpon miniatum may absorb sulfur directly from rock substrates. Indeed, preliminary data suggest that this species, in all probability, selectively occupies substrates with high sulfur content. Therefore, the high sulfur values for this species probably do not indicate high levels of airborne sulfur. For this reason, I recommend that future elemental analysis studies be limited to the two corticolous Letharia species.

6. In comparing elemental analysis data from the Sawtooth National Recreation Area with other western U.S. study areas, it appears that data from the Sawtooth fits somewhere between the wilderness area in the Salmon National Forest and the Jarbidge Wilderness Area (northeastern Nevada). For example, sulfur values for Letharia vulpina, from the Salmon National Forest, are very low ranging between 0.025% and 0.135%, while sulfur values for the same species in the Jarbidge Wilderness Area range between 0.102% and 0.226%.

Recommendations:

1. It is essential that additional data be collected from several other sites, particularly on the west side of the forest where pollution impact from the Boise area may be a problem.
2. I suggest that we limit future elemental analyses to the two corticolous Letharia species. By all indications these species provide excellent baseline information for evaluating accumulation of airborne pollutants.
3. Further collections from various habitats in the Sawtooth National Recreation Area are necessary in order to finalize a complete checklist of the lichens of the area. This checklist will provide an essential baseline for monitoring radical changes in the lichen Flora of the Sawtooth National Recreation Area.
4. Analysis of at least sulfur content for the pollution sensitive indicator species every five years is essential, and the flora should be reevaluated every ten years.

TABLE 1. SUBSTRATE, RELATIVE ABUNDANCE AND DISTRIBUTION INFORMATION FOR THE LICHEN SPECIES OF THE SAWTOOTH NATIONAL RECREATION AREA, SAWTOOTH NATIONAL FOREST, IDAHO. (R= rare, C= common, A= abundant, Cr= crustose, Fo= foliose, Fr= fruticose, Um= umbilicate, and Sq= squamulose)

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
<i>Acarospora</i> <i>chlorophana</i> (Cr)	Rock				R
<i>Acarospora</i> <i>fuscata</i> (Cr)	Rock				R
<i>Aspicilia</i> <i>calcareo</i> (Cr)	Rock	R	R	R	R
<i>Bellemerea</i> <i>alpina</i> (Cr)	Rock	R	R	R	R-C
<i>Biatora</i> <i>vernalis</i> (Cr)	Bark			R	
<i>Brodoa</i> <i>oroarctica</i> (Fo)	Rock				R
<i>Bryoria</i> <i>abbreviata</i> (Fr)	Bark		R	R	
<i>Buellia</i> <i>punctata</i> (Cr)	Bark		R-C	R-C	
<i>Caloplaca</i> <i>epithallina</i> (Cr)	Epiphyte				R
<i>Caloplaca</i> <i>holocarpa</i> (Cr)	Bark			R	
<i>Caloplaca</i> <i>tirolensis</i> (Cr)	Detritus				R-C
<i>Candelariella</i> <i>aurella</i> (Cr)	Detritus				R
<i>Candelariella</i> <i>deflexa</i> (Cr)	Bark		R	R	

TABLE 1. cont.

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
Candelariella rosulans (Cr)	Rock	R-C			R-C
Catapyrenium lachneum (Sq)	Soil	R			
Cladonia Chlorophaea (Sq)	Soil		R-C	R-C	
Cladonia pocillum (Sq)	Soil	R			
Cladonia pyxidata (Sq)	Soil/Bark			R	
Cyphelium tigillare (Cr)	Decorticated wood	R		R	
Dermatocarpon miniatum (Um)	Rock		R-C	R-C	R-C
Dermatocarpon moulinsii (Um)	Rock	R-C			
Hypogymnia imshaugii (Fo)	Bark		R		
Lecanora argopholis (Cr)	Rock	C			C
Lecanora hagenii (Cr)	Selaginella				R-C
Lecanora impudens (Cr)	Bark			R	
Lecanora muralis (Cr)	Rock			R	
Lecanora piniperda (Cr)	Decorticated wood				R
Lecanora polytropa (Cr)	Rock	C	C	C	C

TABLE 1. cont.

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
Lecanora "pseudomellea" (Cr)	Rock				R-C
Lecanora rupicola (Cr)	Rock				R-C
Lecanora "sierrae" (Cr)	Rock				R
Lecanora thomsonii (Cr)	Rock	C		C	C
Lecidea atrobrunnea (Cr)	Rock		C-A	C-A	C-A
Lecidea tessellata (Cr)	Rock	C	C	C	C
Lecidea turgidula (Cr)	Bark	R		R	
Lecidella carpathica (Cr)	Rock			R	
Lecidella euphorea (Cr)	Decorticated wood	C-A	C-A	C-A	
Lecidella stigmathea (Cr)	Rock		R-C	R-C	R-C
Lepraria neglecta (Cr)	Soil	R			
Letharia columbiana (Fr)	Bark	A			A
Letharia vulpina (Fr)	Bark	A	A	A	A
Melanelia exasperatula (Fo)	Bark		R-C		
Melanelia granulosa (Fo)	Rock				R

TABLE 1. cont.

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
Melanelia incolorata (Fo)	Rock		R-C	R-C	R-C
Melanelia sorediata (Fo)	Rock			R	
Melanelia subolivacea (Fo)	Bark		C	C	
Parmeliopsis ambigua (Fo)	Bark	C	C	C	C
Peltigera aphthosa (Fo)	Soil				R
Peltigera canina (Fo)	Soil	R-C	R-C	R-C	
Peltigera malacea (Fo)	Soil		R	R	
Phaeophyscia endococcina (Fo)	Rock			R-C	
Phaeophyscia orbicularis (Fo)	Rock	R			
Physcia albinea (Fo)	Rock				R
Physcia caesia (Fo)	Rock			R	
Physcia dubia (Fo)	Rock			R	R
Physconia detersa (Fo)	Rock			R	
Physconia muscigena (Fo)	Over moss	R			R
Platismatia glauca (Fo)	Bark			R	
Protoparmelia badia (Cr)	Rock				R

TABLE 1. cont.

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
Pseudephebe minuscula (Fr)	Rock	R-C		R-C	R-C
Rhizocarpon disporum (Cr)	Rock			R-C	R-C
Rhizocarpon geographicum (Cr)	Rock	R-C		R-C	R-C
Rhizocarpon simillimum (Cr)	Rock				R
Rhizocarpon superficiale (Cr)	Rock				R
Rhizoplaca chrysoleuca (Um)	Rock			R	
Rhizoplaca melanophthalma (Um)	Rock			C	C
Rinodina milvina (Cr)	Rock		R	R	
Sporastatia testudinea (Cr)	Rock				A
Staurothele clompima (Cr)	Rock			R-C	
Staurothele fissa (Cr)	Rock	R			
Tephromela armeniaca (Cr)	Rock				R
Trapeliopsis granulosa (Cr)	Bark		C	C	
Umbilicaria hyperborea (Um)	Rock			R-C	R
Umbilicaria krascheninnikovii (Um)	Rock				C-A

TABLE 1. cont.

SPECIES/ GROWTH FORM	SUBSTRATE	NORTH ALPINE BASIN	ALPINE LAKE	FARLEY LAKE	FLYTRIP BASIN PASS
Umbilicaria vellea (Um)	Rock		R		
Umbilicaria virginis (Um)	Rock	C		C	C-A
Xanthoparmelia taractica (Fo)	Detritus/rock				C
Xanthoria elegans (Fr)	Rock				C-A
Xanthoria fallax (Fo)	Bark			R	

TABLE 2. ELEMENTAL ANALYSIS DATA FOR SELECTED LICHEN SPECIES FROM SELECTED SITES IN THE SAWTOOTH NATIONAL RECREATION AREA.

STUDY SITE	Cu (ppm)	Pb (ppm)	S(%)
SPECIES/SUBSTRATE			
NORTH ALPINE BASIN			
Letharia vulpina (bark)	6.30	12.00	0.174
Letharia columbiana (bark)	7.10	14.10	0.058
Dermatocarpon miniatum (rock)	10.90	12.10	0.434
ALPINE LAKE			
Letharia vulpina (bark)	4.80	18.10	0.118
Dermatocarpon miniatum (rock)	21.30	10.20	0.276
FARLEY LAKE			
Letharia vulpina (bark)	2.00	10.20	0.179
Dermatocarpon miniatum (rock)	7.70	102.50	0.476
FLYTRIP BASIN			
Letharia columbiana (bark)	1.00	9.10	0.162